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" AN IMPROVED DEVICE FOR ELECTROLYTIC ETCHING OF ALUMINIUM FOIL USING DIRECT CURRENT."

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH Rafi Marg, New Delhi - 110005, Indian, an Indian registered body incorporated under the Registration of Societies Act (Act XXI of 1960)

The following specification describes the nature of this invention.

PRICE : TWO RUPEES

148324

THis is an invention by Shri BALKUNJE ANANTHA SHENOI, Scientist, Shri RANGASAMY RADHAKRISHNAN, Scientist, Shri KANDADAI RAJAGOPALCHARI NARASIMHAN, SHRI VENKATASUBRAMANIAN LAKSHMINARASIMHAN, Scientist, Shri DEVARAJ KANAGARAJ, Senior Scientific Assistant and Shri ANGUSAMY PERUMAL, Senior Laboratory Assistant all are Indian nationals and all are employed in the Central Electro chemical Research Institute, Karaikudi-6 Tamil Nadu, India.

This invention relates to improvements in or relating to feeding of direct current for etching of aluminium foil by means of contact cell.

Hitherto it has been proposed to feed the direct current to aluminium foil by means of electrical contact shoes or stationary brush/es or contact rollers. The aluminium foil passes over these contacts before entry into the etching bath.

This is open to the objection that the use of electrical contact rollers, shoes or box for feeding the direct current, leads to arcing between the foil and the contact structure. The foil gets punctured at these arcing sites. The molten aluminium from those arc sites adheres strongly over the contact roller which subsequently causes servere arcing. Therefore the contact structure has to be cleaned periodically with emergy cloth during the process. Moreover the side of the foil exposed to contact structure is abraded which leads to improper etch pattern on that side.

The object of this invention is to obviate these disadvantage by feeding direct current to aluminium foil for electrolytic etching by using a contact cell. The necessary direct current for the electrolytic process is supplied to the stationary anodes G in the contact cell A which contains alkali solution M and, to the stationary cathodes J in the etching tank D of the accompaning drawings which contains our patented etching electrolytes K (Indian Patents Nos. 139702 & 141250. The aluminium foil which moves over and around the drive and idler rollers R is cathodic in the contact cell A and anodic in the etching tank D. It is claimed that by making the aluminium foil a cathode in the contact cell the following two advantages are achieved:

i) Current is fed to the foil from its anode G without friction, arcing and abrasion,

and ii) The Aluminium foil is degreased cathodically and therefore the degreasing step which is the first operation in our electrolytic etching process is made complete

The foil emerging out of the contact cell is washed in running tap water in the tank B and subsequently treated in acid in the tank C. The foil after acid treatment enters the etching tank where the electrochemical etching of Al foil is carried out. The nature and strength of the acid is so carefully choosen such that drag out of acid by the foil into etching electrolyte favours in getting better etched foil which is an added advantage to the process.After electrochemical etching, the foil is given all the post treatment operation described in our earliest Indian Patent 141250.

To these ends, the invention broadly consists in electrochemical etching of aluminium foil by subjecting it as cathode in a contact cell containing an alkaline solution and then as anode in our patented etching electrolytes.The following examples are given to illustrate the invention.

EXAMPLE - 1

Electrolyte for Contact Cell:

Sodium hydroxide	:	10% w/v
Temperature	:	50°C
Anode material	:	Mild steel plate
Anode c.d.	:	0.48A/cm^2
Cathode	:	100 μ thick 250 mm wide superpurity aluminium foil
Cathode c.d.	:	0.5A/cm^2

After alkali degreasing in contact cell the foil is washed in tap water followed by treatment in 10% v/v of Hcl for 2 min. at room temperature.

Etching electrolyte: (Indian Pat. No.141250)

Sodium chloride	:	20% w/v
Sodium sulphate	:	7.5% w/v
Boric acid	:	4% w/v
Temperature	:	100°C
Cathode	:	Stainless steel
Anode	:	The same aluminium foil
Anode c.d.	:	0.8A/cm^2

The aluminium foil is processed in the continuous etching plant at 50 cm per min. lenear speed.

EXAMPLE - 2

Electrolyte for contact cell same as given in Example-I.

After alkali degreasing in contact cell the aluminium foil is washed in tap water and then treated in 10% v/v of HNO_3 for 2 min. at room temperature.

Etching electrolyte :(Indian Pat. No. 139702)

Sodium chloride	:	22.5% w/v
sodium citrate	:	7%
Citric acid	:	1.0%
Temperature	:	100°C
Cathode	:	Stainless steel
Anode	:	The same aluminium foil
Anode c.d.	:	0.8A/cm^2

The aluminium foil is processed in continuous etching plant at 50 cm. per min. lenear speed.

The following are the main advantages of this invention:

The arcing between the foil and the contact-roller is eliminated

Feeding the necessary direct current and degreasing the aluminium foil are done in a single bath.

Dated this 9th day of August 1977.

Sd/--
Asstt.Patents Officer,
Council of Scientific & Industrial Research

148324

THE PATENTS ACT. 1970

COMPLETE SPECIFICATION
(Section - 10)

"AN IMPROVED DEVICE FOR ELECTROLYTIC ETCHING OFALUMINIUM FOIL USING DIRECT CURRENTS".

COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH, Rafi Marg, New Delhi - 110001, India, an Indian Registered body incorporated under the Registration of Societies Act,(Act XXI of 1860)

The following specification particularly describes and ascertains the nature of this invention and the manner in which it is to be performed:-

This is an invention by Balkunje Anantha Shenoi, Scientist, Rangasamy Radhkrishnan, Scientist, Kandadai Rajagopalachari Narasimhan, Scientist, Venkatasubramanian Lakshminarasimhan, Scientist, Devaraj Kanagaraj, Senior Scientific Assistant, and Angusamy Perumal, Senior Laboratory Assistant, all are Indian Nationals and are employed in the Central Electrochemical Research Institute, Karaikudi-6, Tamilnadu, India.

This invention relates to an improved device for electrolytic etching of aluminium foil using direct current.

Hitherto it has been proposed to feed the direct current to aluminium foil by means of electrical contact shoes or stationary brushes or contact rollers. The aluminium foil passes over these contacts before entry into the etching bath.

This is open to the objection that the use of electrical contact rollers, or shoes or brushes for feeding direct current, leads to arcing between the foil and the contact structure and the foil gets punctured at those arcing sites. The molten aluminium from these arc sites adhere strongly over the contact roller which subsequently causes further severe arcing. Therefor the contact structure has to be cleaned periodically with emery cloth during the etching operation. Moreover the side of the foil exposed to contact structure is abraded which leads to improver etch patt-ern on that side. So the object of the present invention is to obviate these disadvantages by feeding direct current to aluminium foil for electrolytic etching by means of a contact cell.

The contact cell is provided with two pairs of U shaped stationary electrodes. The electrodes are positioned exactly parellel to the path of the foil. The electrodes are connected to anode bus bar of the etching rectifier. First the foil is

made to pass through the pair of anodes in the contact cell. Then the foil is taken through a running water washing tank, acid dip tank and then through pairs of U shaped stationary electrodes kept in the etching tank. The movement of the foil through various tanks as stated above is achieved by fixing external and internal rollers at proper positions with respect to the processing tanks. Sodium hydroxide is taken in the contact cell as a contact cell electrolyte. Any one of the etching electrolyte described in our Patent Nos. 141250 and 139702 is taken in the etching tank. The foil is drawn through all the processing tanks at a fixed predetermined linear speed as described in our earlier Indian Patent No.139258. Then the rectifier is switched on and the required direct current for etching the aluminium foil is impressed. According to the set up described above the aluminium foil becomes cathodic in the contact cell and anodic in the etching tank. So the aluminium foil is cathodically degreased in the contact cell and anodically etched in the etching tank. The use of contact cell eliminates the problems of arcing, friction and abrasion. Feeding the direct current for electrochemical etching and degreasing are carred out in a single step.

Accordingly this invention provides an improved device for electrolytic etching of aluminium foil using direct current which consists of means to pass aluminium foil over a series of external and internal rollers through containers with alkaline solution, tap water, an acid solution and an etching electrolyte in series, characterised in that a pair of stationary anodes in the form of perforated metal sheets are fixed in the alkaline bath immersed parallel to the path of the foil and a pair of metal cathodes are fixed in the etching electrolyte bath immersed parallel to the path of the foil and means to pass the current to the said electrodes.

The device for feeding direct current for etching of aluminium foil thus comprises (i) a pair stationary anodes in the form of perforated sheets, positioned exactly parallel to the path of the foil, immersed in an electrolyte such as pottassium or sodium hydroxide in the concentration range from 2 to 10% W/V kept at a temperature of 20 to 55°C (ii) a tank containing running tap water (iii) a tank containing hydrochloric or nitric acid in the concentration range from 2 to 10% V/V a-t room temperature (iv) two pairs of stationary cathodes in the form of perforated sheets, positioned exa-ctly parallel to the path of the foil immersed in an etching electrolyte (v) a series of internal and external rollers fixed suitably with respect to the tanks to enable the aluminium foil to pass through all the processing tanks wherein the direct current of 0.3 to 1.2 A/cm^2 is fed to the aluminium foil through the anodes in the contact cell, the foil is washed treated in acid and etched between the cathodes in the etching solution.

The etched foil is given all the post treatment such as treatment in acid, jet washing, washing in running tap water, protective coating produced on the foil by means of special electrolyte, dried and wound on a spool as described in our earlier Indian Patent No.141250. The foil is drawn through all the processing tanks at a predetermined linear speed as described in our earlier patent no.139258.

The invention will now be described with the help of drawing accompanying the provisional Specification which is the diagrammatic view of the invented device. The aluminium foil F is made to pass through all the processing tanks A,B,C and D by means of internal and external rollers R. A pair of V shaped M.S. electrodes G in the form of perforated sheets are positioned exactly parallel to the path of the foil. The electrodes are kept in an rectangular M.S. tank A containing

sodium or potassium hydroxide solution H in the concentration range between 2 to 10% W/V. The foil F, electrodes G and the alkali solution H constitutes the contact cell. The rectangular aluminium tank B contains running tap water to wash the foil free of alkali. The rectangular PVC tank C containing acid such as hydrochloric or nitric acid in the concentration range from 2 to 10% V/V completely removes the alkali over the surface of the foil. Two pairs of "U" shaped stainless steel electrodes J in the form of perforated sheets are fixed exactly parallel to the path of the foil and immersed in an etching electrolyte K kept in an rectangular rubber or ebonite lined M.S. tank D. The two pairs of electrodes J, the foil F and the electrolyte K constitute the etching step. The mild steel electrodes G in the contact cell tank A is connected to the anode bus bar and the stainless steel electrodes J in the etching tank D are connected to the cathode bus bar of the etching rectifier. The foil is drawn at a predetermined liner speed through all the processing tanks A, B, C and D. When etching current is impressed to the electrodes G and J, the aluminium foil F becomes cathodic in the contact cell tank A and anodic in the etching tank D. So the foil takes the impressed current from the electrodes G through solution H and etched in the solution K between the electrodes J.

The following examples are given to illustrate the invention.

EXAMPLE - 1

Electrolyte for Contact cell		
Sodium hydroxide	:	10% W/V
Temperature	:	50° C
Anode material	:	Mild Steel plate
Anode c.d	:	0.48 A/ cm^2
Cathode	:	100 μ thick 260 mm wide super purity aluminium foil
Cathode c.d.	:	0.5 A/ cm^2

After alkali degreasing in contact cell the foil is washed in tap water followed by treatment in 10% V/V of HCl for 2 min. at room temperature.

Etching electrolyte : (Indian Patent No. 141250).

Sodium chloride	:	20% W/V
Sodium sulphate	:	7.5% W/V
Boric Acid	:	4% W/V
Temperature	:	100°C
Cathode	:	Stainless Steel
Anode	:	The same aluminium foil
Anode c.d.	:	0.8 A/cm^2

The aluminium foil is processed in the continuous etching plant at 50 cm per min. lenier speed.

EXAMPLE-II

Electrolyte for contact cell same as given in example. 1. After alkali degreasing in contract cell the aluminium foil is washed in tap water and then treated in 10% v/v of HNO_3 for 2 min. at room temperature.

Etching electrolyte : (Indian Patent No. 139702).

Sodium chloride	:	22.5% w/v
Sodium citrate	:	7% w/v
Citric acid	:	1.0% w/v
Temperature	:	100° C
Cathode	:	Stainless steel
Anode	:	the same aluminium foil
Anode c.d	:	0.8 A/cm^2

The aluminium foil is processed in continuous etching plant at 50 cm. per min. lenier speed.

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EXAMPLE III

Electrolyte for contact cell :-

Potassium hydroxide	:	7% W/V
Temperature	:	50°C
Anode material	:	Mild Steel Plate
Cathode	:	100 μ thick 250 mm wide super purity aluminium foil
Cathode c.d	:	0.5 A/cm^2

After alkali degreasing in contact cell the aluminium foil is washed with tap water and then treated in 10% V/V of HNO_3 for 2 minutes at room temperature.

Etching electrolyte (Indian Patent No. 139702).

Sodium chloride	:	22.5% W/V
Sodium citrate	:	7% W/V
Citric acid	:	1.0% W/V
Temperature	:	100°C
Cathode	:	Stainless steel
Anode	:	The same aluminium foil.
Anode c.d	:	0.8 A/cm2

The aluminium foil is processed in the continuous etching plant at 50 cm/min linear speed.

The use of contact cell eliminates the problems of arcing, friction and abrasion, Feeding the direct current for electro-chemical etching and degreasing the aluminium foil are achieved in a single step.

The current is fed from the anodes through the alkali electrolyte to the aluminium foil in the contact cell. The foil becomes cathodic in the contact cell and gets cathodically degreased. The foil becomes anodic in the etching electrolyte and gets anodically etched between the cathodes kept in the etching tank.

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WE CLAIM :

1. An improved device for electrolytic etching of aluminium foil using direct current consisting of means to pass aluminium foil over a series of external and interal rollers through containers with alkaline solution, tap water, an acid solution and an etching electrolyte in series, characterised in that a pair of stationary anodes in the form of perforated metal sheets are fixed in the alkaline bath immersed parallel to the path of the foil and a pair of metal cathodes are fixed in the etching electrolyte bath immersed parallel to the path of the foil and means to pass the current to the said ~~anodes~~ cathodes

2. The device as claimed in claim 1 wherein the anodes used are mild steel electrodes connected to an anode bus bar of an etching rectifier for feeding of 0.3 to 1.2 A/cm^2 of the direct current.

3. The device as claimed in claims 1 or 2 wherein the alkaline solution has 2-10% W/V of potassium or sodium hydroxide kept at a temperature of 20°to 55°C, the acid solution is 2 to 10% V/V of hydrochloric acid or nitric acid at room temperature and the etching electrolyte used is as described in Indian Patents No. 139702 and 141250.

4. An improved device for electrolytic etching of aluminium foil use direct current substantially as herein described and illustrated.

Dated this 9th day of Nov. 1978.

(I.M.S.MAMAK)
Scientists (Patents)
COUNCIL OF SCIENTIFIC AND INDUSTRIAL RESEARCH.

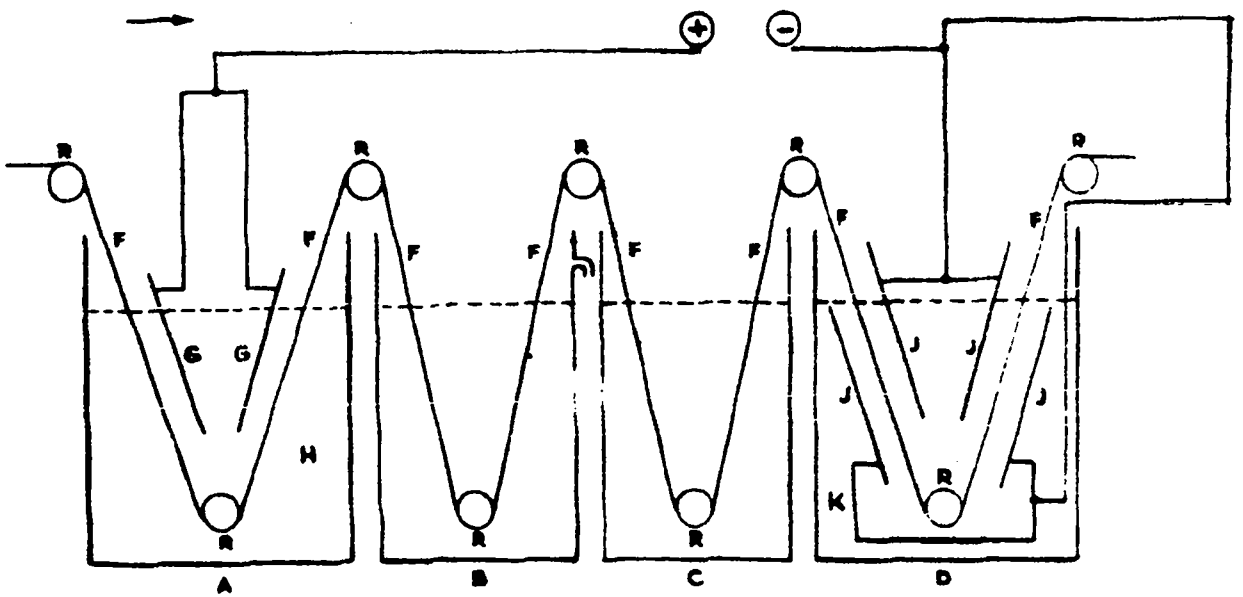
COUNCIL OF SCIENTIFIC & INDUSTRIAL RESEARCH

No. 148324

Provisional

No. OF SHEETS

SHEET NO.



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